A Survey on Context-Aware Monitoring Strategies for Cloud Based Healthcare Systems

Article history:
Received 28 August 2015
Accepted 15 September 2015
Available online 15 October 2015

Keywords:

ABSTRACT
Introduction: The role of cloud computing and bigdata in assisting healthcare management systems have seen a steep rise in the recent few years. Specifically, context aware monitoring is an upcoming technology that possesses the strength of providing efficient real-time healthcare services. As per IBM Data Scientists, the four dimensions(4Vs) of bigdata are volume, variety, velocity and veracity. Such a dimensional data has a definitive need to be securely stored and transmitted because of its high impact of future healthcare infrastructure. Objective: The objective of this paper is to provide a detailed investigation on various context aware monitoring strategies for cloud based healthcare systems. The paper also surveys certain tools, algorithms and methodologies employed in cloud for medical data storage management. Results: An inference of existing system and proposed techniques/strategies/methodologies/algorithms employed by various researchers is derived. Conclusion: The paper concludes by enumerating strong points to migrate healthcare records to clouds, that would aid the best in emergency situation. This paper would promote a lot of research in the area of application of cloud computing techniques for medical system.

INTRODUCTION

The Cloud Computing has emerged as a new computing paradigm which aims to provide dependable, personalized, dynamic computing environments focused towards enhanced value of service and IT infrastructure. Cloud computing has been obtainable in recent years with new innovations and business applications. Cloud computing will persist to increase and control users information communication because it offers many compensation, allowing users to have easy instantaneous and individualized access to tools and information, in portable manner when and wherever they need also locatable from any networked device. Cloud computing in healthcare has become tight bond relationship between the care provider and the patient. Cloud technology supports cooperation and team based care delivery and the ability to use applications based on their necessities and a general set of medical information. It can be done on a platform that allows healthcare organizations to deliver, use and integrate the medical data to the authority which hold all the sensitive data. This will require maintaining a level of security and privacy equal to or greater than what conventional IT provides.

This paper presents a detailed investigation on various context aware monitoring strategies for cloud based healthcare systems prevailing in literature. The paper is organized as follows: Section 2 describes about synergizing cloud, bigdata and healthcare. Section 3 gives a broad overview of role of WEKA data mining tool in assisting healthcare systems. Section 4 gives a detailed survey of various context-aware monitoring strategies prevailing in literature. Section 5 concludes the paper giving the future research direction. Table 1 portrays the evolution of various automated healthcare management strategies proposed by several authors.

2. Synergizing Cloud, Big Data and Healthcare:
Abdur Rahim Mohammad Forkan, Ibrahim Khalil, Ayman Ibaida and Zahir Tari (2015)
described about the big data analysis in the environment of the cloud. They had proposed the unusual conditions of the patients having variations in the Blood Pressure and Heart Rate by implementing the model in a correct and complete manner. The technique used in this model is Association rules and robust learning method which avoids the false alerts to the monitoring system. The solution involves methodical move towards carrying the increasing community of people with chronic illness who lives alone and requiring an assist care.

R. Buyya, C. Yeo, S. Venugopal, J. Broberg, and I. Brandic (2009) described about the cloud computing and architecture of cloud in market oriented resource allocation using the virtual machine. They proposed about the structural design of the market oriented allocation of resource in the cloud. The technique named State-of-Art which compromise the Qos between the users and providers to establish Service Level Argument’s. They provided additional solution for the environment of the programming and the tools that allows the fast making of the cloud applications in the cloud environment.

G. Wu, H. Zhang, M. Qiu, Z. Ming, J. Li, and X. Qin (2012) described about the data mining in the way of decentralized approach in a distributed system. They proposed decentralized reach to detect, filter and discover events in their temporal correlations. The algorithm used in this process is Map reduce-based algorithm, Map reduce Apriori using the association rules in the data mining compute all the resource in the multiple nodes of the system. They had provided the solution to speedup distributed system by using the apriori based centralized mining approach.

Rajeev Rastogi and Kyuseok Shim (2002) defined the optimized association rules which focus on the uninstanitiatedattributes. They proposed the optimized association rules in the three ways they are 1) Disjunction over uninstantiated attributes are permitted in association rule 2) Arbitrary number of uninstantiated attributes are allowed in association rules and 3) These attributes can be either numeric or categorical. Additionally they offered pruning and graph search algorithm. The solution for the attributes rule is providing algorithm for graph search and pruning to eliminate paths in which optimized rule applied in appropriate manner.

3. The Role of WEKA Tool in Assisting Healthcare:

Mark Hall and et al (2009) described about WEKA workbench and the history of the WEKA. They proposed new projects of the WEKA tools and the emerging projects of the WEKA. In each version of WEKA they have used different methods and techniques. In WEKA 3.6 they have used predictive Modelling Markup Language (PMML model) it is XML-based set which express data mining and statistical models. The solution provided is the WEKA project that uses WEKA tool, which is a open source software has provided less success, thus maintainable and changeable are based on the specified company.

Sebastian celis and David R. Musicant (2002) defined about the WEKA parallel to show the important of increase in speed by lowering the time to estimate the dataset using classifier. They proposed about the WEKA parallel for cross validation calculations and transparent power of multiple computers. The technique named Cross-Validation technique is used to calculate the success of generalization. This technique breaks the data into dissimilar segments and run the algorithm in another segments and uses the left over data to test the result. They had provided the solution for machine learning algorithms by using n-fold cross validation testing to increase their performance.

Vincent S. Tseng, Lee-Cheng Chen, Chao-Hui Lee, Jin-Shang Wu, Yu-Chia, Hsu (2008) described about the medical care system to provide alerts in time before the harsh chronic illness. They proposed a system which mines the data about the chronic patient monitoring with the purpose of considering the cardiovascular patients. The techniques used is Paroxysmal Atrial Fibrillation (PAF) database which is based on bio-signal generated in Electrocardiogram (ECG) complete investigation is made and prediction on chronic illness is implemented via ECG without the use of medical rules.

4. Context-Aware Monitoring Strategies in Literature:

Federica Paganelli, Emilio Spinicci and Dino Giuliani Mobile Health Assistance Network (ERMHAN), a multichannel context aware service platform which is designed to support networks in cooperating and sharing information to improve the patient value of life. They have proposed ERMHAN is a context aware mobile platform which supports mobile care givers in day-to-day activities. They use ontology based context aware computing and service oriented approach. The solution is designing a modular system and adapts standard technologies. This makes the system extensible to match specific patient requirements in an ambient intelligent environment.

Pari Delir Haghighi, Arkady Zaslavsky, Shonali Krishnaswamy, Mohamed medhat Gaber (2009) defined about the implementation and evaluation construction of health monitoring application. They have proposed the novel approach for Situation-Aware Adaptive Processing of streams of data for smart and real time examination of data. The fuzzy logic approach is used in Situation Aware Adaptive Processing (SAAP) of data stream.

Rakesh Agrawal and Rama Krishan Srikant (1994) described new algorithms for showing the problem in discovering association rules between
items in a large database of transaction sales. They proposed two algorithms that are combined as hybrid algorithm called AprioriHybrid with increase the transaction number and size in the database. AprioriHybrid algorithm is defined which involves, managing the real world application in large database. The solution that is been obtained is when there is a large number of item in database the execution time decreases. This in term decreases the execution time, which resulted in the possibility of using the aprioriHybrid in all the real applications having large database.

Jeffrey Dean and Sanjay Ghemawat (2008) defined map reduce programming model in Google for altered determination. They proposed map reduce which are capable of using machine resource and fit for large computational problems in the Google. They used map reduce programming model for handling and producing large datasets. The solution obtained in this method is the programming model, network bandwidth has become a rare source and it had reduced the failures and data loss.

Table 1: Evolution of Various Automated Healthcare Management Strategies Proposed by Several Authors.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Year</th>
<th>Authors</th>
<th>Existing System</th>
<th>Proposed System</th>
<th>Proposed Technique/Strategies Employed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1994</td>
<td>R. Agrawal, R. Srikant et al.</td>
<td>Performance gap increased with the problem size</td>
<td>Increase the transaction number and size in the database</td>
<td>AprioriHybrid algorithm</td>
</tr>
<tr>
<td>2</td>
<td>2002</td>
<td>R. Rastogi and K. Shim</td>
<td>Generalized association rules to extract the seasonal and patterns of multiple attributes</td>
<td>1) Disjunction over uninstantiated attributes are permitted in association rule 2) Arbitrary number of uninstantiated attributes are allowed in association rules and 3) These attributes can be either numeric or categorical</td>
<td>Pruning and graph search algorithm</td>
</tr>
<tr>
<td>3</td>
<td>2002</td>
<td>B. P. McGrath et al</td>
<td>The ambulatory monitoring for 24 hours</td>
<td>Sphygmomanometer cuff to measure the blood pressure for every 15 to 30 minutes</td>
<td>Ambulatory Monitoring</td>
</tr>
<tr>
<td>4</td>
<td>2002</td>
<td>S. Ce Lis and D.R. Musciant</td>
<td>WEKA process the datasets at low rate</td>
<td>WEKA parallel has High n-fold cross validation</td>
<td>Machine learning algorithms</td>
</tr>
<tr>
<td>5</td>
<td>2008</td>
<td>J. Dean and S. Ghemawat</td>
<td>It uses special purpose computations that process large amount of data</td>
<td>Large cluster of Machine resource and fit large computational problems in the Google using map reduce</td>
<td>Map reduce Map-Key value pairs Reduce-Function</td>
</tr>
<tr>
<td>6</td>
<td>2008</td>
<td>V. S. Tseng, L.-C. Chen, C.-H. Lee, J.-S. Wu, and Y.-C. Hsu</td>
<td>The medical care system provides alerts using the medical rules</td>
<td>The chronic illness is monitored with ECG without medical data rule</td>
<td>Paroxysmal Atrial Fibrillation (PAF) database</td>
</tr>
<tr>
<td>7</td>
<td>2008</td>
<td>F. Paganeli, E. Spinici, and D. Giuli</td>
<td>Chronic care model which provides improved efficiency in patients</td>
<td>ERMHAN is a context aware mobile platform which supports mobile care givers in daily activities</td>
<td>Ontology based context aware computing and Service oriented approach</td>
</tr>
<tr>
<td>8</td>
<td>2009</td>
<td>P. Haghighi, A. Zaslavsky, S. Krishnaswamy, and M. Gaber</td>
<td>Ubiquitous data stream techniques lightweight and data stream mining algorithm</td>
<td>Situation Aware Adaptive Processing for smart and real time analysis of data</td>
<td>Situation Aware Adaptive Processing</td>
</tr>
<tr>
<td>10</td>
<td>2009</td>
<td>R. Buyya, C. Yeo, S. Venugopal, J. Broberg, and I. Brandic</td>
<td>SLA-oriented resource allocation and global cloud exchange market</td>
<td>High performance computing workloads and internet based service workloads</td>
<td>State of Art technique</td>
</tr>
<tr>
<td>11</td>
<td>2012</td>
<td>G. Wu, H. Zhang, M. Qu, Z. Ming, J. Li, and X. Qin</td>
<td>Detect events in database and perform data mining</td>
<td>Distributed system mines event using association rules, Map reduce algorithm detect efficiency</td>
<td>Map reduce-based algorithm, Map reduce Apriori</td>
</tr>
<tr>
<td>12</td>
<td>2015</td>
<td>Abdur Rahim Mohammad Forkan, Ibrahim Khalil, Ayman Ibaida, Zahir Tari</td>
<td>Context aware monitoring using Cloud oriented context aware monitoring (COCAMAAL)</td>
<td>Big data context aware monitoring (BDCAM) for learning knowledge discovery process</td>
<td>Ambient Assisted Living (AAL) system</td>
</tr>
</tbody>
</table>

Thomas G. pickering, Daichi shimbo and Donald Haas (2002) defined about the mean level above extended periods, which describes about the true blood pressure of the patients. They proposed
about the ambulatory blood pressure monitoring by using the sphygmomanometer cuff which is worn on belt, which monitors the blood pressure every 15 to 30 minutes throughout the day and night. The technique named Ambulatory Monitoring is used to advance the assessment of the true solution for patient suffering from hypertension by diagnosing them using clinical blood pressure measurements. The night time blood pressure is also monitored in this method.

5. Conclusion and Future Work:
Portability of critical clinical data, sharing information securely and accessibility of data from different healthcare centers for treatment process can simplify the whole healthcare service. Portable medical data result in simplifies the medical data process and also helps to retrieve whenever we need. Cloud computing involves in sharing of data, accessing of sensitive data and storing. Mainly cloud environment can provide improvements in system efficiency & density. Cloud storage service is accessed through the cloud computer functionality or through a storage technique gateway. As technology is developing day by day cloud medical processing becomes a necessary process. This paper would promote a lot of research in the area of cloud assisted healthcare systems.

ACKNOWLEDGEMENT

S. Balamurugan, V.M. Prabhakaran and R.P. Shermey wishes to thank Dr. R. Nedunchezhan, Director-Research and Vice Principal, of their institute, KIT-Kalaignarkarunanidhi Institute of Technology, for sowing the seeds of thinking big in research within them, his expert guidance, continuous motivation and quality time spent by him. Authors wish to thank Dr. B. Ramparakash, M.D.(Gen. Medicine), D.M.(Cardiology), Fellowship in Electrophysiology, Consultant Cardiologist and Electro physiologist, GKNM Hospitals, Coimbatore, Tamilnadu, India for the subject guidance provided by him.

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